

ES 335: Machine Learning

Quiz 1 — Foundations, Trees & Nearest Neighbours

Date: 2026-08-28

Duration: 50 minutes

Maximum marks: 30

SET A

Name: _____ Roll No.: _____

Instructions

- Write your name and roll number before starting.
- This paper has 12 questions in 3 parts, for a total of 30 marks.
- Record your final MCQ answers in the answer grid below — the grid is what gets graded.
- All logarithms are base 2 unless stated otherwise.
- Calculators are permitted; devices with network access are not.

MCQ Answer Grid

Q	1	2	3	4	5	6
Ans						

Part A — Multiple Choice

12 marks

Choose the single best answer unless a question says otherwise.

Q1. A binary classifier produces the confusion matrix below.

[2 marks]

	Predicted +	Predicted −
Actual +	40	10
Actual −	20	30

What is its precision?

- (A) 40/60
- (B) 70/100
- (C) 40/100
- (D) 40/50

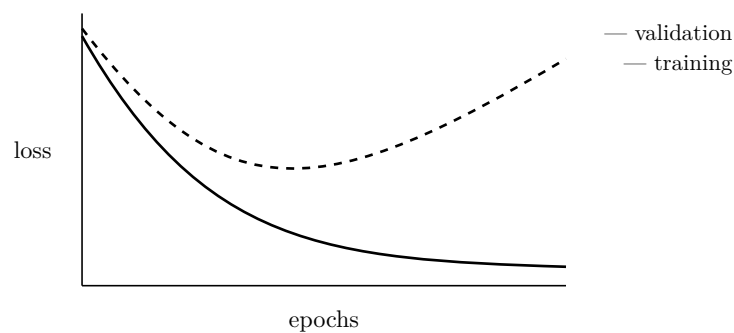
Q2. For a split that sends all positives left and all negatives right, the weighted entropy of the children is:

[2 marks]

- (A) $\log_2 3$
- (B) 0
- (C) 1
- (D) 0.5

Q3. The curves below were logged during training.

[2 marks]



What is the most appropriate response?

- (A) Train longer — the model is underfitting
- (B) Increase model capacity — both losses are too high
- (C) Lower the learning rate — training has diverged
- (D) Stop earlier or regularize — the model is overfitting

Q4. Which of the following objectives are convex in their parameters? *(Select all that apply.)* [2 marks]

- (A) Linear regression with squared loss
- (B) Logistic regression negative log-likelihood
- (C) A two-layer neural network with squared loss
- (D) The k -means clustering objective (jointly in assignments and centroids)

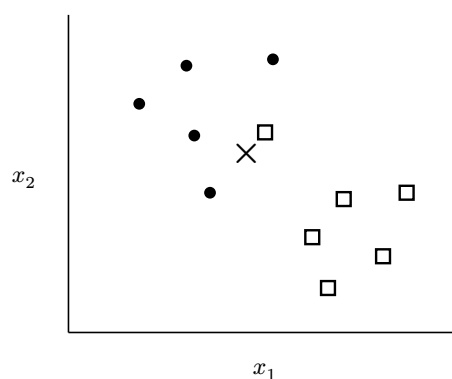
Q5. Increasing k in k -NN typically has which effect?

[2 marks]

- (A) Increases bias, decreases variance
- (B) Increases both bias and variance
- (C) Decreases bias, increases variance
- (D) None of the above

Q6. The figure shows training points from two classes and a query point $\times$.

[2 marks]



Using Euclidean distance, how does the query point get classified by 1-NN and by 3-NN respectively?

- (A) 1-NN: class B ($\square$), 3-NN: class B ($\square$)
- (B) 1-NN: class A ($\bullet$), 3-NN: tie
- (C) 1-NN: class A ($\bullet$), 3-NN: class A ($\bullet$)
- (D) 1-NN: class B ($\square$), 3-NN: class A ($\bullet$)

Part B — Fill in the Blanks

4 marks

- Q7.** Computing inner products in a high-dimensional feature space without ever constructing the features is known as the kernel _____. [1 mark]
- Q8.** For linear regression in matrix form, the least-squares solution is $\hat{\theta} = [2 \text{ marks}]$
 $(X^\top X)^{-1} X^\top$ _____.
- Q9.** Compared with L2, L1 regularization tends to produce weight vectors that are [1 mark]
 _____.

Part C — Long Answers

14 marks

Answer in the space provided; show your working.

- Q10.** The table records eight days of data for predicting whether a match is *Played*. [5 marks]

Day	Outlook	Windy	Played
1	Sunny	No	Yes
2	Sunny	Yes	No
3	Overcast	No	Yes
4	Overcast	Yes	Yes
5	Rainy	No	Yes
6	Rainy	Yes	No
7	Sunny	No	No
8	Rainy	No	Yes

Compute (i) the entropy of *Played*, and (ii) the information gain of splitting on *Windy*. Which single-feature split would a decision tree prefer if the gain for *Outlook* is 0.311?

- Q11.** Starting from $L(\theta) = \|y - X\theta\|_2^2$, derive the normal equation. State the condition [5 marks]
 under which the solution is unique, and give one practical remedy when it is not.

- Q12.** Your colleague reports 99.2% accuracy on a fraud-detection dataset in which 0.8% of *[4 marks]* transactions are fraudulent. Explain why this number is not impressive, and name two evaluation metrics (or tools) better suited to this setting, justifying each in one line.

— *End of paper* —